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SCIENCE

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THE NEW BOTANY.

BY LESTER F. WARD, WASHINGTON, D.C.

THIS is an age of new sciences; at least we have a new chemistry, a new astronomy, and a new geology. May we not have a new botany? The real science of botany is what we know of the origin and nature of plants. All other knowledge about plants is preparatory to this. Not only is this true of descriptive botany, which is merely taking off the slabs, as it were, but it is true of structural botany, even where this becomes histological. What has been the object of all the thorough and profound investigations of the German botanists? To show how the existing vegetation has become what it is and how the various kinds of plants are related to one another from the standpoint of real kinship. In a word, it is the development of plant life that constitutes the true science of botany. And think of the enormous labor and research that it has required to arrive at this through the study of the existing plants alone! Whether we consider the working-out of the anatomical structure of all the various types of vegetation in order to conclude from the different grades of tissue along what lines development has taken place, or whether it be the reproductive organs that engage attention, from the relationships of which the course of botanical evolution may be inferred, the task in either and in any case is immense and has properly engrossed the attention and absorbed the energies of the foremost students of that noble science. And it is proper that the great universities should have prominent chairs of botany to push on the solution of the still unsolved problems of the vegetable world.

But there are two routes that lead to these important results. There are two methods by which the development of plant life may be studied. The one I have outlined is what Huxley has so happily called "the method of Zadig."[1] The past is seen through the present and ancestral forms are inferred from the marks they have stamped upon their posterity. It is a true scientific method, usually the best that nature affords, and it has led us to the greater part of the knowledge we possess with respect to the evolution of world systems, of our own planet's history, and of the development of organic beings

But far better than this method of "retrospective prophecy" or rational inference, wherever it can be applied, is the method of direct comparison. No one claims that the nature of a form can be reasoned out from no matter how complete a series of facts with the same certainty that it can be learned if it can be actually brought forward for direct observation. Yet this latter is the method of paleontology in all the departments of life to which it can be applied. In the animal kingdom this great resource is freely drawn upon, but in the study of plants it is almost entirely neglected. In all Europe I can only name one chair of botany, that of the University of Strasburg, which is occupied by one who has paid special attention to the paleontological side. In America there is none, and yet we have several able students of botanical evolution from the morphological side, who are doing excellent work. I will not be deemed invidious if I mention the thorough and successful researches of Professor Douglas H. Campbell of the Leland Stanford, Jr., University.

Why have we not equally competent men at work upon the ancient forms? It can no longer be said that the material is wanting. It exists in vast quantities and excellent quality. There have been already collected and not yet at all studied fossil plants enough to furnish employment for a corps of investigators during the balance of the present century. But what exists is nothing to what may be easily obtained. I could direct any one to hundreds of localities where a little labor would certainly be rewarded by abundant results. In nearly all the geological formations of the United States, from the Devonian to the Pleistocene, there exist rich beds of vegetable remains, as yet only slightly explored, which, if thoroughly developed and studied, would, with scarcely any doubt, throw more light on the evolution of our American floras than any amount of histological investigation of those floras themselves as we now find them could be expected to do.

Without going into details, and omitting entirely the Paleozoic floras, which as every one knows, are very rich in America and have been chiefly studied, a glance at the Mesozoic and Cenozoic series may be of interest. It begins, so far as we now know the plant-bearing horizons, with the Upper Trias, but this, as I have shown,[2] is found in nine of the States and Territories of the Union, and has already yielded 119 species of fossil plants, sufficient to fix with great accuracy the geological position of the beds and show the general character of the vegetation that flourished on this continent at that remote period. We also know that extensive Permian deposits occur in the West, and there is hope that the interval between these and the plant-bearing Trias may yet be bridged over by the discovery of Lower Triassic forms.

We as yet know nothing of the Jurassic flora of America, unless the Trinity beds of Texas, the supposed Kootanie deposits of Montana, and the lowest Potomac strata of Virginia prove to reach downward into that system. But in these and the great series of clays that overlie them and seem to occupy the entire interval to the Laminated Sands of New Jersey, placed in the Upper Cretaceous, we have an immense period represented by successive plant-bearing horizons, and by scarcely any other remains of life, from which, at this writing, nearly a thousand different plant forms are known, with large collections still awaiting study. If to this we add the great Dakota formation of Kansas and Nebraska, we nearly double these figures, and have a Lower and Middle Cretaceous flora that compares favorably in its number and extent with that of the same areas at the present day.

Between this and the rich Laramie flora of the extreme Upper Cretaceous there is a newly-discovered plant-bearing horizon in the Montana formation, probably the equivalent of the Belly River series of the Canadian geologists, the flora of which is as yet very little known.[3] Of the Laramie flora I need scarcely speak[4] further than to say that all that has thus far been done is merely preliminary to the elaboration of the extensive collections that I have myself made in this vast store-house of facts bearing upon the history and nature of plant life on this continent.

Overlying the Laramie, or perhaps forming an upper member of it, and occupying wide areas west of the great plains, are other plant-bearing deposits, some of them now known as the Denver formation, others of more doubtful age embracing the Carbon and Evanston coal-fields of Wyoming, others farther north long known as the Fort Union group, and all taken together nearly or quite filling the interval from the recognized Laramie to the Green River group, about whose Tertiary age there has never been any question; and this last itself has entombed along with its beautiful fishes and with insects a great number of vegetable remains in an admirable state of preservation.

In Montana, about the sources of both the Upper Missouri and the Yellowstone Rivers, especially in the Bozeman coal mines

[1] Nineteenth Century for June, 1880, vol. vii., p. 929.

[2] Bulletin of the Geological Society of America, Proceedings, vol. iii., 1891, pp. 23-31.

[3] See the American Journal of Science for April, 1884, 3d Series, vol. xxvii., pp. 292-303.

[4] See my Synopsis of the Flora of the Laramie Group. Sixth Annual Report of the U. S. Geological Survey, 1884-85, pp. 399-557, pl. xxxi.-lxv.; also, Types of the Laramie Flora. Bulletin of the U. S. Geological Survey, No. 37.

and on the flanks of the Amethyst Mountain in the National Yellowstone Park, the series, probably beginning as early as Laramie age, is represented by an almost unbroken succession of plant-yielding deposits, extending upward into the Volcanic Tertiary, where the ruins of vast Sequoian forests mantle the slopes with their erect and prostrate trunks, among whose still persisting roots of stone lie buried in great profusion the more delicate parts, branches, leaves, fruits, and even flowers, of a rich and varied flora. Thousands of beautifully preserved impressions of these have been collected by Professor Knowlton and myself in two field seasons' operations, besides a most extensive series of the silicified wood, showing its internal structure as perfectly as if it were still living.

On the other side of the great continental divide, in California, Oregon, and Washington, there are Miocene and still later deposits, in which have been found the later floras of the continent, but whose extent can as yet only be conjectured. Even in Alaska there are great areas which have only to be scratched to make them tell of oaks and willows and a great number of vegetable forms that flourished there in late Tertiary time, the analogues of which are now only found in the latitude of the States and along the Atlantic border.

Is it possible that botanists care nothing for all this? Do they prefer to drudge upon the tissues of living plants to learn what may be known by actually confronting the witnesses themselves of the real character of the ancient vegetation of the earth and the true lines along which it has developed? It cannot be. And yet such would be the logic of their action. The truth is that institutions of learning, much like the masses of mankind, are the votaries of fashion. It is fashionable to found chairs of structural and physiological botany, and it is fashionable to occupy them and work out refined problems in the niceties of the science. Would there were no worse fashions! "These ought ye to have done and not to leave the other undone." The government has led the way, through its several geological surveys, in establishing the existence of these inexhaustible sources of botanical knowledge, but it cannot, and probably should not, sustain the careful and prolonged researches necessary to the solution of the many and important scientific problems that naturally grow out of such a mass of information. It can only use the data thus accumulated in the settlement of the geological questions involved, and in the development of the economic resources of the country to which they serve as aids. The purely scientific results belong to the higher institutions of learning to work out. It is true that only the great and well-endowed ones can conveniently undertake this work, but these are in condition to do so, and there is nothing that could reflect greater credit upon an American university. Such institutions make themselves a history by the original research they foster and not by their pedagogic achievements. A proper amount of teaching in the form of lectures growing out of laboratory work is useful to give precision to such work as well as to instruct, but it should never engross the energy of the teacher to the exclusion of the chief object, the advancement of science. In this case the materials are bulky and their collection and transportation expensive, yet several leading American colleges have frequently indulged in this part of the expense, and then, strangely enough, stopped there, and stored their cellars with undetermined material; or, if they have gone further, as at Princeton, and been to the expense of installing the specimens in their museums and employing a curator to take charge of them, they only cumber their shelves with unnamed and unknown objects, to be looked at as mere curiosities.

To set forth any detailed plan for putting these suggestions into practice would unduly prolong this article, but surely no one will claim that the prosecution of paleobotanical research is impracticable in a country that boasts of such universities as those at Chicago and at Palo Alto. All that is needed is that its importance be recognized; the task of reducing it to practice is only a matter of administration. The difficulty is to persuade educators to look to value instead of custom in the encouragement of research. The great energy that is devoted to small things is only less strange than the little energy that is devoted to great things, and a new and advanced spirit needs to be breathed into our higher education.

The new botany is not merely the study of plants from the paleontological side; it is their study from all sides and from all points of view, and a school of botany in a great modern university should no more limit itself to the facts that living plants present than a school of history should be narrowed down to the old method of recounting the deeds of kings, dynasties, and warriors as constituting all of human history. The mere "determination" of fossil plants, although of course the most laborious part, is a comparatively unimportant part from the botanical standpoint. The great work is their affiliation. As I have shown, we have in America a succession of plant-bearing horizons not so widely separated in time but that the later forms may be in large degree affiliated upon the next earlier ones, so that, in the right hands, there is hope that something like a complete history of plant development may be ultimately worked out. No grander theme presents itself to the scientific world, and the time is ripe for its inauguration. Hitherto the study of fossil plants has been conducted wholly from the geological standpoint, and, as I have been obliged to insist,[1] this does not necessarily involve the correct systematic determination of fossil forms, provided their identity can be surely recognized wherever found. A new method is therefore loudly called for, by which far greater certainty than heretofore can be reached in establishing the real nature and affinities of extinct floras. In other words, they must be studied from the botanical standpoint and all the light brought to bear upon them that the known flora of the whole globe is able to shed. This is no simple task, it is one that demands the highest ability and the widest facilities. But thus pursued, with sufficient time, patience, and labor, its success is certain, and its value beyond calculation.

THE STRUCTURE OF INSECT TRACHEÆ, WITH SPECIAL REFERENCE TO THOSE OF ZAITHA FLUMINEA.

BY DR. ALFRED C. STOKES, TRENTON, N.J.

THE following paper has a threefold purpose. First, to confirm an important discovery made in this country, but, so far as I have been able to learn, never corroborated in any American publication. It was Professor George Macloskie of Princeton College who announced in *The American Naturalist* for 1884, page 567, that the so-called spiral threads of insect tracheæ are in reality chitinous folds of the membrane, and consequently tubules, which are longitudinally fissured. Professor A. S. Packard, in the same magazine for 1886, page 438, in a paper "On the Nature and Origin of the So-Called Spiral Thread of Tracheæ," says, "All the figures of the spiral thread hitherto published I believe to be incorrect," adding in a foot-note that "Thus far I find myself unable to agree with Professor G. Macloskie that the 'spirals of the proper tracheæ' are 'crenulated thickenings of the intima,' or that the tænidia are really tubular." Unless I have overlooked some more recent American contribution to the literature of the subject, this is the latest statement, with the single exception of a short note from Professor Macloskie himself published in a recent number of *Science*, in which communication his former conclusions are re-affirmed, as the result of another examination of the so-called spirals. But, although Dr. Packard does not accept these conclusions, he suggests the word "tænidium" as a name descriptive of the solid thread, as it is generally considered to be, a name which it may be well to adopt, but with a meaning somewhat different from that attached to it by its learned inventor, who considers the objects which the word describes "to be separate, independent, solid rings, more or less parallel and independent of each other, . . . usually thin, flat, but often concavo-convex, the hollow looking toward the centre of the tracheæ."

Some months ago my correspondent, Mr. Fr. Dienelt of Loda, Illinois, sent me a microscope slide of the tracheæ of the not uncommon aquatic bug *Zaitha fluminea*, for a purpose to be specially referred to hereafter, but one that had no connection with the structure of the tænidia; and, still more recently, at my request, Mr. B. F. Quimby of Chicago collected in Jackson Park, in that city, several specimens of the same insect and kindly sent them

[1] American Geologist, vol. ix., January, 1892, pp. 39-40.

to me, as I had observed on Mr. Dienelt's preparation certain structural points which together form the subject of this paper.

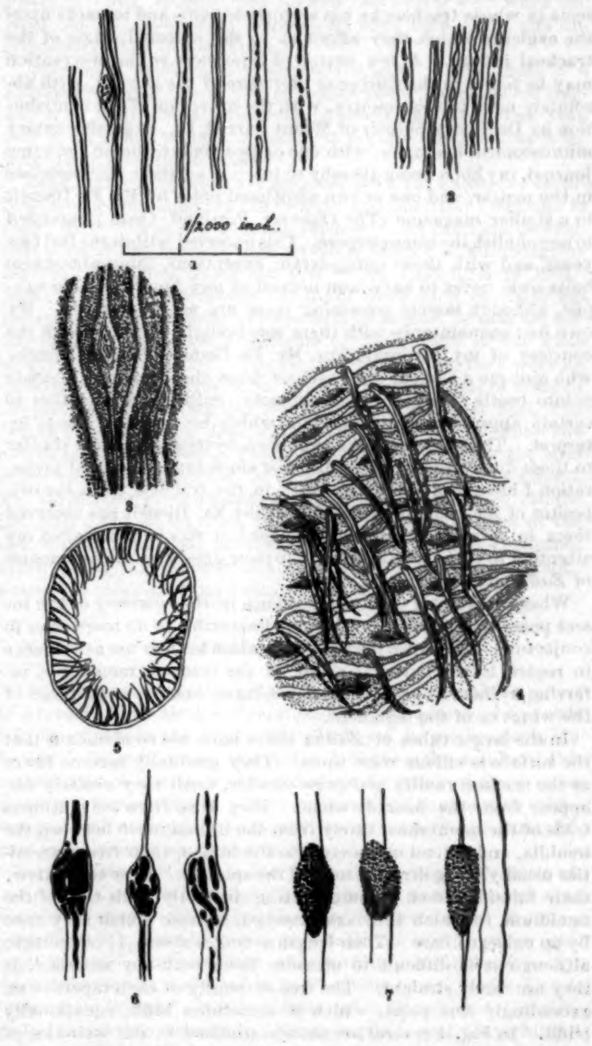
The tracheæ of the insect are large, and, as the tænidia are also comparatively broad, the entire collection of tracheal tubes, especially in the principal trunks, readily lend themselves to investigation. It is here an easy task to demonstrate that the tænidia are fissured tubules formed within and from chitinized folds of the intima, the convexity of the folds looking toward the lumen of the tracheæ, the fissure, as Professor Macloskie has observed, being directed away from that lumen. In balsam mounts, and perhaps somewhat more distinctly in glycerine preparations, under a wide angled, homogenous immersion $\frac{1}{12}$-inch objective, the irregular edges of the longitudinal fissure in each tænidium of the larger tracheæ can be seen and studied at the microscopist's pleasure; indeed, so well marked are they that they may easily be seen with Zeiss's apochromatic 6-millimeter objective, 0.95 N. A., and, in favorable circumstances, with Gundlach's dry $\frac{1}{8}$, N. A. 0.92. The appearances are in no way those of the diffraction phenomena produced by solid fibres, but rather an aspect which suggests the illumination of a hollow tube by reflection from its walls. The method of focussing which gives this bright band yields a picture of the edges of the fissures, with a more or less brilliant space between them. But by using the method employed by every well-informed microscopist when studying the secondary structure of the diatoms, a different appearance is obtained. The method is nothing more than a certain manner of focussing the objective, but one which produces the "black dot resolution" which has revealed so much of importance in reference to the intimate structure of those silicious plants. The "black dot" focus is as correct when applied to these minute tænidia as when obtained over the secondary membranes of the diatoms. With it the margins of the tænidial fissures are separated by a black space that defines them and every irregularity of the edges with convincing distinctness.

These margins are not parallel, a fact which alone would preclude the possibility that the appearances are diffraction phenomena. Neither is the fissure that separates them even in width. It is narrowed in indescribable ways by the approach of one margin toward the other, by a retreat from each other, and by wavy and more or less crenulated outlines. In some tænidia these margins have come in contact and have apparently been united, showing, in many instances, the point of union as an exceedingly slender line, whilst in others the juncture has been obliterated, and in still others the union has been accomplished in such a way that minute and irregular spaces have been left in the course of the original fissure, like little islands of darkness, or of brightness, according as the microscopist uses the black dot resolution, or focusses for the illuminated band.

In Fig. 1 are shown portions of several tænidia exhibiting the fissure, and, although the drawings were originally made with the camera lucida, they are necessarily somewhat diagrammatic. The one two-thousandth inch scale appended, is magnified to the same degree as are the tænidia, but is applicable to these particular drawings only, and not to the spaces between them. In the first two bands on the left-hand side the fissure is shown black, as I think it should be, whilst in the others it is left white, to exhibit rather more distinctly for this purpose the irregular margins and the irregular widths of the fissure. In the last two portions on the right hand side, and in the five of Fig. 2, are delineated some of the various aspects assumed by the union of the edges of the fissures, and the formation of what may be called apertures in a chitinous bridge.

The fissures are so distinctly defined in ordinary preparations that sections of the tænidia are not necessary to show them. Such sections, however, are desirable, but to make them is an impossibility for me. The microscopist that nowadays tries to work alone and without a laboratory at his disposal, and without the refinements of microtomy and of photo-micrography, can do but little at a disadvantage. Yet when a tænidium is traced to the folded and flattened margin of a large trachea, in some instances the narrow, externally concave fissure can be plainly seen, although confusing diffraction effects must there be contended with. A longitudinal section of the tube, that is, a transverse section of these tænidia, would present a superb and convincing picture.

Not only do the tænidia of this special insect (*Zaitha fluminea*) clearly reveal the fact that they are longitudinally fissured tubules, but these tracheæ as clearly show that the so-called spirals are inwardly directed folds of the membrane. This is especially conspicuous near the spiracles, where the tracheæ, both on their internal and external surfaces, exhibit evidences of the fact. Near the spiracles the tracheal membrane is externally studded with minute papillæ, which become fewer and smaller as the distance from the spiracle increases. Here the intima is thrown into folds so shallow and so broad that they are often mere grooves, and with no specially



conspicuous deposit of chitin. Here too the margins of these shallow and groove-like infoldings are crenulated by the papillæ, which become more conspicuous as they are presented in profile on the edge of the furrow. An attempt has been made to show this appearance in Fig. 3, where are delineated three broad and incomplete tænidia, with the tapering termination, or the beginning, of another. Here they are only broad grooves, with no appearance of the narrow fissure of the completed tænidium, as it is now all fissure; in many instances these shallow depressions are even more irregular than shown in the figure. Near the spiracles they are sometimes hardly more than a collection of wrinkles in the crumpled membrane, as is delineated in Fig. 4,

which is an attempt to exhibit a portion of the internal surface of a large trachea near the external orifice, the membrane being hardly more, so far as the tænidia are concerned, than a mass of wrinkles whose folds project into the lumen of the trachea and are scarcely chitinous, when in that respect they are compared with what, for the want of a better name, I have called the completed tænidia.

The second object of my paper is to call attention to certain tracheal appendages which were discovered by Dujardin as long ago as 1849, and by him referred to in a brief note published on page 674 of *Comptes Rendus* for that year. Since then they seem to have been almost forgotten. These are internal, chitinous, hair-like bodies arising from the fold of the tænidia and projecting into the lumen of the tubes. Dujardin gives a list of the insects in whose tracheæ he has seen these hairs, and remarks upon the evidence which they afford as to the external origin of the tracheal intima. A few scattered references to the observation may be found in the European literature of the subject, with absolutely none in this country, with the exception of one contribution by Dr. Henry Shimer of Mount Carroll, Ill., in an elementary microscopical magazine, with one or two made by me in the same journal, my hope being thereby to interest amateur microscopists in the matter, and one or two additional notes by Mr. Fr. Dienelt in a similar magazine (*The Observer*, Portland, Conn.), intended to accomplish the same purpose. This occurred within the last two years, and with these unimportant exceptions, internal tracheal hairs seem never to have been noticed by any American microscopist, although insects possessing them are not uncommon. My own first acquaintance with them was brought about through the courtesy of my correspondent, Mr. Fr. Dienelt of Loda, Illinois, who sent me a slide of the tracheæ from the common Colorado potato beetle (*Doryphora decemlineata*), calling my attention to certain appearances within them which he was at a loss to interpret. These proved to be produced by tracheal hairs similar to those discovered by Dujardin, and since examining that preparation I have seen the appendages in the tracheæ from the ovipositor of the common house fly, whilst Mr. Dienelt has observed them in several other insects; indeed, it was he who called my attention to their abundance and to their great size in the tracheæ of *Zaitha fluminea*.

Whether they are of any importance in the economy of the insect possessing them, it is of course impossible to do more than to conjecture. Dujardin has called attention to their use as evidence in regard to the external origin of the tracheal membrane, referring to them as epidermal appendages, analogous to those of the wings or of the tegument.

In the larger tubes of *Zaitha* these hairs are so abundant that the surface is villous with them. They gradually become fewer as the tracheæ ramify and grow smaller, until they entirely disappear from the finer divisions. They arise from the chitinous folds of the membrane, rarely from the intima itself between the tænidia, and extend obliquely into the lumen, their free extremities usually being directed toward the spiracle. They are hollow, their minute lumen communicating distinctly with that of the tænidium, to which they are attached, or from which they arise by an enlarged base. Their length averages about $\frac{1}{16}$ of an inch, although it is difficult to measure them with any accuracy, as they are rarely straight. The free extremity of each tapers to an exceedingly fine point, which is sometimes bifid, occasionally trifid. In Fig. 4 several are shown attached to the wrinkles of the tracheæ near a spiracle, and in Fig. 5 is exhibited a transverse section of a tube with the hairs projecting into its lumen.

The third and last of the points to which this paper is devoted is one which, so far as I have been able to ascertain, has not been previously observed as a part of the structure of any insect's tracheæ. These are certain minute, elliptical bodies in the tænidia, each with an internal, presumably glandular, appendage, to all appearance forming part of the tænidium from which it springs. Whilst these are numerous in the main trunks and in the larger branches where the hairs are abundant, they are more conspicuous and seem also to be more numerous in those that bear but few of these internal filamentous appendages.

The external bodies were at first supposed to be the remains of hairs which had been broken away in the preparation of the tracheæ for microscopical study, but further examination soon dispelled that illusion, as the objects differ widely from the bases of the hairs, which are only thick-walled circular openings. The enigmatical bodies are more or less elliptical or elongate-ovate in contour, no two being of precisely the same shape nor of the same size, although in size they are rather more constant, the diameter varying from $\frac{1}{5000}$ to $\frac{1}{3000}$ of an inch, the length externally being about $\frac{1}{3000}$ of an inch, or but little longer than the diameter of a human red blood-corpuscle. They are commonly in the tænidia, the lateral margins of the fissure within the latter separating to give them space, and they are perforated in the most irregular way, the small apertures varying in number and in form as the bodies themselves vary in shape, the openings occasionally being reduced to a single circular one. These objects are shown in Fig. 1, within the short tænidium beside the second on the left-hand side; in Fig. 3, where there are two in the broad, shallow folds of the membrane, and more in detail by Fig. 6.

Here again enters another application of the diatomist's black dot resolution which has made plain the structure of the secondary membrane of so many of those plants. In Fig. 6 the black dot resolution shows the perforations, which are always irregular in number and in form, with the space between the uneven edges of the tænidium, and, in the sketch on the right-hand side, the continuation of an aperture with the tænidial fissure.

These elliptical, cribriform bodies seldom occur on the tracheal membrane between the tubules. Occasionally they are seen to form the principal portion of a short, otherwise solid, tænidium, which to all appearance has been produced only to accommodate that special object. In such cases there is but one; usually a single tubule possesses several.

The perforations pass through the substance of the tænidium and are received, usually by means of a short pedicle, in a cushion-like, apparently glandular, body attached to the inner surface and projecting into the lumen of the trachea. In Fig. 7 are shown three of these glandular bodies, if they are glandular; and it is equally difficult to suppose that they are and that they are not. They appear under the microscope as collections of exceedingly minute, rounded apertures, which, in certain positions, may be seen to be continuous with narrow passages directed toward the pedicle, when that exists, and toward the external cribriform plate. Their structure in minuteness is comparable with the secondary structure of the diatoms, which I have so often mentioned, being as exquisite and as difficult to resolve, in this taxing the good qualities of the microscopist's best objectives. The thickness of the cushion-like objects is about $\frac{1}{5000}$ of an inch, a space capable of being occupied by much microscopic structure.

Although they do not commonly occur on the tracheal membrane between the tænidia, they may be found there, as shown in Fig. 4, where is delineated a portion of a crumpled region of the membrane near a spiracle, with a few hairs and with several of these problematical, presumably glandular, bodies scattered about like so many islands in a sea of wrinkles.

What their function may be it is difficult to conjecture. Their position within the lumen of the tracheæ, and their connection with the external cribriform spaces, in no way simplify the problem.

Their presence, however, seems to add a unique scientific value to the tracheal tubes of *Zaitha fluminea*, to say nothing of microscopical interest. A microscopist, with a well-trained and intelligent microtomist to do his bidding, might be able to add much to our knowledge of the structure, not only of these apparently glandular organs of the pedicle and the perforated, elliptical objects, but of certain other regions of these remarkable tracheæ.

CURRENT NOTES ON ANTHROPOLOGY.—XXI.

[*Edited by D. G. Brinton, M.D., LL.D.*]

The So-Called Caucasian Race.

IN a paper which he presented to the Moscow Congress last summer, M. Ernest Chantre, well known for his profound studies in the ethnology of north-western Asia, enters a remonstrance against the erroneous use of the term "Caucasian Race," as

synonymous with "White Race." I take the greater pleasure in seconding his protest, as in my "Races and Peoples" I discarded the term, and gave similar reasons as his own for denying its right to exist in ethnographic classification.

M. Chantre points out that it is demonstrable that none of the so called Caucasian peoples ever lived in the Caucasus or can be traced to the Ponto-Caspian area. The study of local archæology proves that this tract was comparatively lately inhabited; that its occupants in early times, as to-day, had no ethnic unity, but were the *disjecta membra* of various stocks, who fled to these mountain fastnesses as asylums; that they are without linguistic or somatologic connection; and that the only proper use of the term is to apply it solely to the tribes occupying the main chain of the Caucasus, tribes who have no historic or ethnic identity with any others outside this area.

Yet so slowly does a correction of this kind penetrate popular science, which is nearly always made up at second or third hand, that the term "Caucasian race" will probably survive in school geographies and encyclopædias for a generation to come.

The Unity of Religious Conceptions.

The curious similarity between the myths and other religious conceptions of nations far asunder in space and kinship has often impressed students, and has been explained in a variety of ways. An instructive comparison of the early Semites and the Indo-Germanic nations in this respect is given by Dr. W. Schwartz in the *Zeitschrift für Ethnologie*, 1892, heft. III. He shows that there is "a whole cycle of mythical conceptions and narrations which are common to Indo Germanic and Semitic peoples." The books of the Old Testament are a rich mine of such. Some of these can hardly be explained otherwise than as direct borrowing, or, as our author prefers, slightly varied versions from some original stock of conceptions belonging to a common ancestry. He is inclined to consider that the conservation of myths and religious notions is stronger than that of language even. He scarcely seems to allow enough latitude to the fact that certain impressions, which are the same everywhere, are likely to evoke similar expressions of the religious sentiment.

The article is an interesting contribution to the science of religion, and shows a proper understanding of its meaning; being, in this, singularly in contrast with the printed circular issued by those Chicago luminaries who represent the "Department of Religion" in "The World's Congress Auxiliary of the World's Columbian Exposition." This astonishing body has summoned a congress of teachers and members of all faiths, "to indicate the impregnable foundations of theism, and the reasons for man's faith in immortality;" blandly and densely unaware, it would appear, that one or both these dogmas are absent as religious elements in many highly-developed religions! What a spectacle for the world of science!

On Demographic Neurology.

In Dr. Rockwell's letter about the relation of nervous diseases and civilization (*Science*, Dec. 30), he advances several very judicious observations on their prevalence in the United States, though disagreeing with me entirely on the general thesis. As Dr. Rockwell is aware, this is by no means the first time that I have joined issue with him and his friend the late Dr. Beard, on this subject. I shall not renew this discussion, which was carried on in various medical journals, but would ask the attention of readers who would like recent information on the subject to an article by Dr. Irving C. Rosse, professor of nervous diseases in the Georgetown Medical College, which appeared in the *Journal of Nervous and Mental Disease* for July, 1891.

It is entitled "The Neuroses from a Demographic Point of View," and, apart from its medical value, is interesting to the ethnologist as a contribution to comparative nosology. From quite an extended collation of authorities, he shows that there is as much, if not more, nervous disease in low stages of civilization and inferior races than in those which are higher. In the District of Columbia, for example, the decedents among the colored people from nervous diseases often exceed those of the white population thirty-three per cent. Dr. Rosse is inclined to believe that a sudden change in the social habits and condition of any race, at any stage of advancement, will result in a prompt development of neurotic disease. A high civilization, which is stable, excites such a condition less than instability in lower grades. This seems very reasonable.

Ethnography of the Picts.

It used to be taught that the Picts, who once inhabited portions of northern Great Britain, were so called from the Latin *pictus*, painted, because they colored themselves with woad and other paints. They were believed to have been Celts, and linguistically allied to the Welsh.

Both these opinions have been challenged. Their name is a Latinized form of Gaelic *peht* or *peght;* and from the sparse fragments of their tongue preserved, scarcely anything more than lists of kings and names of places, it is quite possible that it belongs to an allophyllic stock.

Their material remains are believed to be the numerous earth-houses or *weems*, found in the Orkney and Shetland Isles, and in many parts of Scotland near the seashore. An excellent description of these has recently been privately printed at Edinburgh by David MacRitchie, under the title "The Underground Life." Many of these subterranean dwellings have been carefully explored by archæologists; but the results it must be said are disappointing. Few objects referable to the culture of the Picts proper can be discerned. The ancient notion that they were an undersized people seems borne out by the narrowness of some of the passages. They are not over four and a half feet high, and two or two and a half feet wide. The walls are of stone and sometimes also the roof. The *weem* is sometimes below the level of the soil, sometimes above it, and is then covered with a mound. Mr. MacRitchie gives a number of plans and illustrations. In the Hebrides these *weems* were inhabited as late as the close of the last century by a class of predial slaves of debased condition, called *sgalag*. Perhaps in this word is to be found the much sought-for original of our colloquial term *scalawag*.

The Craniology of Spain.

Two meritorious authors, Luis de Hoyos Sainz and Telesforo de Aranzadi, published last year an excellent survey of Spanish craniology under the title "Un Avance à la Antropologia de España." In text, maps, and tables, it displays the results of the examination of a number of series of skulls obtained from most of the provinces of Spain. The conclusions are drawn with calmness and under the proper reserves on account of the material from various areas being incomplete.

These conclusions point to the presence in prehistoric times of an "indigenous primitive race," characterized by dolichocephalic, leptorhinic skulls. These became modified by a series of invasions; first, of a brachycephalic people in the north, whom our authors identify with the Celts; then certain sub-dolichocephalic, leptorhinic peoples, supposed to be Visigoths, Suevi, and "Blond Tamau from Africa"; finally certain later Berber and Moorish hordes, which are described as dolichocephalic and platyrrhinic; though the Berbers in the latter respect have the same index as the average Londoner and Parisian to-day, that is, between 46 and 47.

The most interesting point of the discussion, that which is peculiarly the duty of Spanish craniologists to decide, namely, as to whether the primitive stock was identical in osteology with the Basques of the Pyrenees, is left unclear. The fact is, he would be a daring anthropologist who would positively say what the Basque type of skull is. The assertion of Quatrefages, that it is the *tête de lièvre* shape, has now no supporters in Spain. The evidence has proved inconclusive, and with it falls the theory that the Portuguese kitchen-middens are of Basque origin, as it was on such skulls that the theory was based.

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NOTES FROM THE CORNELL INSECTARY.

BY M. V. SLINGERLAND, CORNELL UNIVERSITY, ITHACA, N. Y.

II. — Some Observations Upon Plant-Lice

More than three-quarters of a century ago Kyber, a German observer, published under a similar title the results of experiments which not only confirmed the earlier observations of Bonnet and De Geer, but which also threw increased light on the generation and development of Aphids. Kyber found, for instance, that by keeping the insects in a warm room a series of agamic generations was produced which extended through four years without the intervention of the sexual forms. However, no record was kept of the number of generations produced during the time. In 1779, thirty-six years before Kyber's experiment, Bonnet had carried *Aphis sambuci* through nineteen generations without commerce with the male insect. From these and similar experiments a law has been educed, which we dare not deny, that "under certain circumstances a female Aphis may, without coupling, continue propagating to infinity, provided that the necessary conditions for the development of young — food and heat — are not wanting."

April 2, 1890, nearly two years and ten months ago, the writer isolated a nymph recently born of a wingless agamic female plant-louse, and since that time the experiment has been continued and is now in progress in the green-house at the Insectary of the Cornell Agricultural Experiment Station. The insect is probably *Myzus achyrantes* Monell, one of the "green-flies" of florists, which is always to be found in considerable numbers upon the varieties of *Achyrantes* grown in the Insectary; at one time it also attacked buckwheat and radishes growing in the green-house.

The experiment has been conducted in the following manner: The first nymph was isolated by placing her on a small plant known to be free from Aphids, and this plant was kept in a cage made by placing the flower-pot in a large saucer partly filled with sand, and then placing over the plant and pot a glass cylinder, which sank for a slight distance into the sand, and was covered with Swiss muslin at the top. The nymph was examined daily, and when she became a mother two or three of her young would be isolated in similar cages. When these daughters of the original mother became mothers themselves, their young would also be isolated, and so on. Not all of the young of each parent were allowed to live, and sometimes, to save cages, a mother would be removed to give place to one of her daughters; usually, however, a mother would not be destroyed until some of her daughters became mothers, for it frequently happened that some of the nymphs first isolated died before becoming mothers. In some cases the mother was left undisturbed, the young being removed and counted every day or two, to see how long she would live, how many nymphs might be born of a single mother, and whether there was any diminution in the reproductive power as generation after generation passed by without the male element again entering into the case. Great care has been taken to insure the isolation of the nymphs; when there was any doubt as to the pedigree of the nymph, she was immediately replaced by one of known pedigree.

Nothing but wingless agamic females have thus far been produced in the cages. Winged forms are sometimes seen, in April especially, on the other *Achyrantes* plants in the Insectary. The following table has been prepared to show the number of the generations, the rapidity with which they have been produced, and many other interesting points which have been brought out during the two years and ten months that the writer has cared for these little creatures — my pets, as I call them.

Generations.	When Nymphs were Isolated.	When Motherhood Began.	Age When Reproduction Began.
1	2 Apr. 1890	14 Apr. 1890	12 days
2	18 " "	30 " "	12 "
3	6, 9 May "	18, 28 May "	12 and 19 "
4	26, 28 " "	6, 11 June "	11 " 14 "
5	25 June, 9 July "	12, 20 July "	17 " 11 "
6	12, 13 " "	26, 31 " "	14 " 18 "
7	29 " "	8 Aug. "	10 "
8	8, 9 Aug. "	18 " "	10 " 11 "
9	20, 21 " "	3, 1 Sept. "	14 " 11 "
10	1, 5 Sept. "	13, 15 " "	12 " 10 "
11	18 " "	17 Oct. "	29 "
12	17, 27 " "	15, 10 Nov. "	29 " 14 "
13	10, 13 Nov. "	11, 8 Dec. "	31 " 25 "
14	8, 11 Dec. "	12, 5 Jan. 1891	35 " 25 "
15	5, 12 Jan. 1891	26, 28 " "	21 " 16 "
16	26 Jan. 2 Feb. "	14, 16 Feb. "	19 " 14 "
17	14 " "	27 Feb., 4 Mar. "	13 " 18 "
18	27 Feb. 4 Mar. "	20, 23 " "	21 " 19 "
19	20, 30 " "	10 Apr. "	21 " 11 "
20	6, 8 Apr. "	16, 20 " "	10 " 12 "
21	16, 21 " "	27 Apr., 5 May "	11 " 14 "
22	27 " "	10 " "	13 "
23	10 May "	26 " "	16 "
24	27 " "	10 June "	14 "
25	10 June "	22 " "	12 "
26	24 " "	10 July "	16 "
27	10 July "	21 " "	11 "
28	21 " "	30 " "	9 "
29	31 July, 14 Aug. "	11, 24 Aug. "	11 " 10 "
30	24 " "	5 Sept. "	12 "
31	5 Sept. "	18 " "	13 "
32	22 " "	5 Oct. "	12 "
33	5 Oct. "	27 " "	12 "
34	27 " "	11 Nov. "	15 "
35	14 Nov. "	30 " "	16 "
36	8 Dec. "	14 Dec. "	11 "
37	22 " "	4 Jan. 1892	13 "
38	4 Jan. 1892	23 " "	19 "
39	23 " "	10 Feb. "	18 "
40	10 Feb. "	24 " "	14 "
41	24 " "	10 Mar. "	15 "
42	10 Mar. "	25 " "	15 "
43	25 " "	8 Apr. "	11 "
44	5, 12 Apr. "	20, 25 " "	15 " 13 "
45	20 " "	5 May "	15 "
46	5 May "	18 " "	8 "
47	13, 16 " "	25 " "	12 " 9 "
48	25 " "	4, 7 June "	10 " 13 "
49	5 June "	22 " "	17 "
50	22 " "	4 July "	12 "
51	4 July "	13 " "	9 "
52	13 " "	22 " "	9 "
53	18 Aug. "	1 Sept. "	14 "
54	1, 6 Sept. "	13 " "	12 " 7 "
55	16 " "	26 " "	10 "
56	26 " "	7 Oct. "	11 "
57	7 Oct. "	22 " "	15 "
58	22 " "	7 Nov. "	16 "
59	7 Nov. "	21 " "	14 "
60	21 " "	6 Dec. "	15 "
61	9 Dec. "	27 " "	18 "
62	27 " "	17 Jan. 1893	21 "

Let me point out a few of the most interesting facts to be gleaned from an examination of the above table. Sixty-two generations have been produced thus far, or nearly two (1.8) generations a month on an average. The extremes were in the 13th and 14th generations, when it took a month for a generation to develop; and in the 46th, 47th, and 48th generations, which were all produced within a month.

This difference was due to the fact that the plants had become old, stunted, and pot-bound when the 13th and 14th generations of the Aphids were produced, while in the other case the plants were young and vigorous. It was also found that this difference in the plants produced not only the retardation of development of the Aphids, but there was also a very marked difference in their size and reproductive power. On these stunted plants it takes from two to three times as long for the nymph to develop, it does not attain more than one-third the size, and less than one-third

as many young are produced as there would be if the nymph were reared upon a vigorous young plant. I have seen mother Aphids, on old plants, which were not larger than nymphs after their second moult on young plants. In the 12th generation this point was well illustrated. Here we have the record of two nymphs, the first, isolated Sept. 17 on an old pot-bound plant, did not become a mother until Nov. 15, or 29 days after; while a nymph, isolated 10 days later on a young, vigorous plant, attained motherhood in 14 days. The 19th generation presents a similar case. Nymphs born of these dwarfed and retarded mothers and placed on young plants have become normal-sized mothers in from 15 to 18 days in my cages.

In one instance (54th generation) a nymph became a mother in 7 days, while one of the 14th generation was 35 days in attaining the adult stage. I believe, that by carefully watching the Aphids and always isolating the first nymphs born upon young, vigorous plants, that at least thirty generations of this *Achyrantes* Aphis could be produced in a year. In 1890, Mr. W. J. MacNeil, while studying a black chrysanthemum Aphis, at the Insectary, reared, in 13 months and 5 days, thirty-two generations of the insect, all agamic wingless females. As the table shows, I have reared from twenty to twenty-five generations of the *Achyrantes* Aphis in a year.

As the experiment progressed, many other interesting facts were learned which could not be included in the table. I will now briefly discuss some of them.

The mother Aphids were often caught in the act of giving birth to a daughter. The operation required about five minutes, and in every instance the nymph was born tail end first in a thin transparent sheath or pellicle. Before being entirely delivered from the mother, however, the nymph begins to work the pellicle off; the antennæ and first pair of legs are freed about the same time, then follow the remaining legs and the honey-tubes, and the pellicle appears as a minute whitish mass about the tail of the nymph. The nymph remains attached to the mother until its appendages are free and the little creature is able to stand alone.

There seems to be no published record of the young of wingless agamic female Aphids being born in a pellicle as just described. Buckton gives five or six instances in as many genera where the young of winged agamic females are born thus. I believe, however, that this manner of giving birth to their young is as common among the wingless as among the winged agamic forms of Aphids. I have observed it many times in the case of *Myzus achyrantes*, and several times in the field among other common species. Mr. MacNeil showed it to be true of the black chrysanthemum Aphis; and Mr. W. E. Rumsey, while studying the woolly apple-louse, *Schizoneura lanigera*, here at the Insectary, watched under a compound microscope one of the wingless agamic females giving birth to a daughter, and there was no doubt that the nymph was born in a pellicle. This last case is contrary to the observations of Mr. L. O. Howard as published in Comstock's Report as U. S. Entomologist for 1879, p. 259; but the fact remains that a wingless agamic female of *Schizoneura lanigera* here at the Insectary has been clearly seen in the act of giving birth to several nymphs, each enveloped in a pellicle.

The nymphs begin to suck the sap of the plant very soon after birth, and as they increase in size moults occur. The minuteness of the insects and the delicacy of their cast skins renders the observation of the numbers of the moults very difficult. I worked nearly five months before I satisfactorily settled the fact that the *Achyrantes* Aphis moults four times during its lifetime. My method was to use a small plant with a few leaves and place a piece of stiff black paper close around the plant on the surface of the soil. This was necessary, as the delicate white cast skins frequently fell from the plant and would have been easily lost unless this smooth black surface had caught them.

The records of four nymphs of the 7th, 9th, and 15th generations show that the first moult occurs from 3 to 4 days after birth; the second from 2 to 5 days after the first; the third from 1 to 3 days after the second; and the fourth from 3 to 5 days after the third. In one instance, when the growth of the nymph was retarded by a stunted plant, its moults occurred about one week apart. It requires from 15 to 20 minutes to complete a moult.

The nymphs of a black chrysanthemum Aphis and of *Schizoneura lanigera* also moulted four times, as recorded in the theses of Messrs. McNeil and Rumsey. *Pemphigus flaginis* and *Tetraneura ulmi* are also recorded as moulting four times; thus four seems to be the normal number of moults among plant-lice.

Under the more even temperature during all the seasons in a green-house, plant-lice there do not show such a wonderful fecundity and rapidity of production as has been recorded from field observations. The table above shows that the seasons have no material effect upon the rapidity with which the generations are produced in a green-house.

To ascertain whether the fecundity of the Aphids diminished through the successive generations of the agamic females, I counted the number of nymphs born of a single mother in several instances. During the 1st and 2d generations, 37 nymphs were born of a single mother. In the 3d generation, 3 to 4 nymphs were born each day of a single mother for 14 days in succession. A mother of the 18th generation lived 63 days and gave birth to 59 young. In the 20th generation a mother gave birth to 63 daughters in 19 days, or at the rate of three a day. Sixty-one nymphs were born of a mother of the 35th generation in one month. A mother of the 46th generation gave birth to 15 young in 3 days. Fifty-four daughters were born to a single mother of the 41st generation. And in the 54th generation a mother gave birth to 55 young. It is thus seen that the reproductive power of the agamic females has not decreased through nearly 60 generations.

Mr. MacNeil had one wingless agamic female of the black chrysanthemum Aphis which gave birth to 70 young in 34 days; at one time 7 were born in 27 hours. Mr. Rumsey reared in one instance 68 nymphs in 65 days from a wingless agamic female of *Schizoneura lanigera*; this female lived 12 days after the birth of the last nymph, and was nearly three months old when she died. From another female Mr. Rumsey reared 86 young in 55 days. Several of the agamic females of the *Achyrantes* Aphis have lived two months after becoming mothers.

To learn whether winged females might not be produced if the plants became overcrowded with the Aphids, I allowed, in several instances, reproduction to go on undisturbed in the cages. Several hundred wingless females would accumulate on a small plant, and possibly winged forms might have been forced in time if in each instance the overcrowding had not been checked by a fungous growth, which set in and destroyed a majority of the insects.

Many volumes have been written upon the habits and life histories of plant-lice; enough has been written upon the grape Phylloxera alone to fill a small library. And yet we have much to learn about plant-lice. I believe they present as varied, peculiar, interesting, and wonderful phases in their habits and life histories as do any other insects.

THE EXTREME HEAT AND COLD ENDURED BY MAN.

BY THE MARQUIS DE NADAILLAC, PARIS, FRANCE.

THE exceptional faculties of Man enable him, alone of all the mammals, to battle with extreme cold as with extreme heat, and it is with real astonishment that we ascertain what men of our race can endure. In the earliest times of which we have any knowledge, we have strong evidence that our species lived, both in America and in Europe, when large extents of both continents were covered with ice and when his companions were the elephant and the woolly rhinoceros. Later, the Aryan race, whatever may have been its birthplace, reached step by step in the south the Gangetic Peninsula, 8° only removed from the equator, and, in the north, Iceland and Greenland, which seem the extreme points attained by our most prolific race in those days so distant from ours.

A few years ago the English and Russian officials assembled at Maruchak for the delimitation of Afghanistan suffered a mean temperature of — 20° C., which was considered moderate in those regions. In his eventful journey across the mountains of Central Asia, utterly unknown to us, Prince Henry of Orleans had to

support a cold of − 40° C. (mercury is congealed at − 39° C.; alcohol alone, highly rectified, can mark the low temperatures we give here), with piercing northern winds. The horses and camels died; man resisted.

The northern parts of America have known still more severe colds. Captain Back reported at Fort Reliance − 56.74° C., and Captain Dawson, at Fort Rae, in 62° 30′ north latitude, − 67° C., in April, 1882. Other explorers have never observed such low temperature. The Abbe Petitot gives us − 40° C., as the mean temperature of January at Fort Good Hope, and − 35° C. for January, and − 42° C. for February, at Yukon, Alaska.

In Siberia we find the coldest points inhabited by comparatively civilized men. In the government of Yenissei, the winter time is double the summer time. Autumn sets in in August, and the Yenissei River is completely frozen by the month of October. Yakoutsk was long considered the coldest town of the world. During the winter months the thermometer is as low as − 45° C. But Yakoutsk must yield to Verkhoyansk, a small Siberian town at the mouth of the Lena, where we find − 55° C. in January. And yet this cold is far from being the most severe suffered in those dreary regions. A Frenchman, Mr. Martin, recently dead, travelling in Eastern Siberia, wrote to the Society of Geography, of Paris, that he experienced in 59° north latitude and 132° east longitude a cold of − 63° C.

Physical phenomena, the differences in the relation of the continents and the oceans, have a greater importance than was suspected some years ago. Yakoutsk, which I have just mentioned, is only 6° nearer the pole than Edinburgh, and numerous arctic islands are on the same latitude. Yet Edinburgh and these islands enjoy a much warmer climate, thanks to the Gulf Stream, so well studied by Lieutenant Maury, one of the glorious scientists of our day.

This is probably the cause that some of the polar lands do not always experience the extreme cold we find in some parts of Siberia. Captain Nare's careful observations in Grinnell Land, in 1875–6, only give for January − 36° C., for February − 38° C., for March − 39.90° C., for November − 27.12° C., for December − 36.6° C. Nordenskjöld, in one of his latest voyages, speaks of − 47.7° C. We have still higher records. Lieutenant Greely, in his illfated expedition, tells us that during his long stay at Discovery Bay the temperature maxima never exceeded + 50° (Fahrenheit) and was at one time as low as − 66° F. This difference of temperature, supported in a few months time by the same men, is most remarkable. Hunger, dearth of provisions, incredible hardships broke down those who had so bravely suffered extreme cold.

Nothing daunted by the cruel fate of Lieutenant Greely's companions, Lieutenant Peary tried, in his turn, to attain the solution of the northern problem, and, with a courage which does infinite honor to her sex, Mrs. Peary elected to accompany her husband. They wintered, in 1891, in MacCormick Bay, about a hundred miles distant from the great Humboldt Iceberg, and lived for three months under a temperature varying from − 30° C. to − 50° C. without experiencing any very great inconvenience. It is Lieutenant Peary, if I make no mistake, who approached the nearest to the Pole. He got farther than Frederick William's Land and Cape Bismarck, the extreme northern points reached before him.

In one of the last polar expeditions attempted by the English, in the month of November the thermometer marked − 60° C., and on the 25th of January it went down to − 63° C. on board the "Varna" and the "Dymphna," blockaded in the ice.

But probably the highest amount of cold ever suffered by white man is the one recorded by Mr. Gilder, a reporter of the New York *Herald* attached to the expedition which, under command of Lieutenant Schwatka, went in search of Franklin. In the letters sent home during the winter of 1879–80, so severe in all parts of the world,[1] he speaks of the thermometer lower than − 71° C. Here again we find men of our race supporting an almost incredible amount of cold from November, 1879, to March, 1880. Their power of endurance may be attributed to their stay at Camp Daly from August, 1878, to March, 1879. They experienced there a range of temperature from + 14° C. to − 51° C. The members of the expedition had adopted the way of living of the Innuits. Like them, they fed on the raw flesh of the seals and the walrus and absorbed large quantities of oily and fatty matters which prevented the spread of scorbutic diseases, so fatal to many of their predecessors. The tents were rapidly discarded and replaced by *iglous*, the native winter houses of hard frozen ice, which, curious enough, offer a considerable amount of heat. Their clothes were made of reindeer skin without any linen underclothing, so as not to put a stop to perspiration.

Another day I will compile the highest amount of heat supported by men of the white race. I will only mention here that in Algeria, by no means the hottest point of the globe, our soldiers have often seen the thermometer as high as + 51° C., and Mr. Buveyrier, in his travels amongst the Touaregs, noted + 67.7° C. If we compare this extreme heat (and we will certainly find higher points) the difference between − 71° C., recorded in the Schwatka expedition, and + 67.7° C. reach nearly 138° C., and testify, as I said in the beginning, to the remarkable power of endurance of the white race.

[1] As a comparison, I give the lowest temperature experienced in Paris during the last century. January 20, 1788, − 21.5° C.; January 25, 1795, − 23.5° C.; December 9, 1871, − 21.3° C.; December 10, 1879, − 23 9° C.

BEZOARS.

BY ELIZA BRIGHTWEN, GREAT STANMORE, ENGLAND.

THE almost fabulous value set upon Bezoars in olden days, and the medical virtues often attributed to them, invest these concretions, which are found in the alimentary canal of animals, both wild and domestic, with a certain amount of interest; and, although belief in their curative power has long since passed away, it may be deemed worth while to try and put together a few items about their history and uses.

The name of Bezoar appears to be derived from the Persian *påd* (expelling) and *zahr* (poison), in allusion to the supposed virtues of the stone as a remedy for snake-bites and other wounds. Others again derive it from the name of the goat in which one variety is found.

These stones were introduced as medicines in the East by the Arabian physicians in the tenth century, there seems to be no mention of them in Greek or Latin authors, but from the East their use gradually spread into Europe. They are referred to by Frampton as far back as 1580, and as late as 1746 these stones were in use in England, being found in the London Pharmacopoeia of that date. A severe blow to their reputation was administered by Ambrose Paré, who gave a dose of Bezoar to a criminal condemned to death and to whom arsenic had been given, death, however, was the result.

In the Royal College of Surgeons' Museum in London cases may be seen filled with all the various kinds of concretions which have been found in the intestines of different animals, including some very fine bezoars.

They may be roughly divided into six classes: —

1. Balls composed of animal hairs.
2. Those composed of vegetable hairs.
3. The Oriental Bezoars, composed of ellagic acid.
4. The Occidental Bezoars, formed of resin or bezoardic acid.
5. Concretions of phosphate of magnesia, ammonia, and earthy calculi.
6. Ambergris, found in the intestines of the whale.

We will briefly notice facts relating to each of these classes.

I. Animals, especially horses and oxen, are much given to licking each other and themselves, and the loose hairs being swallowed become felted into spherical balls of various sizes, generally black in color, with a hard, shiny surface, which often consists of phosphate of magnesia.

In the College of Surgeons' Museum there is one such hair-ball, taken out of an ox at Buenos Ayres, which measures forty inches in circumference, and one of oval shape, found in a peccary, measures six inches by four in diameter.

II. Vegetable hair concretions are usually formed round some nucleus, such as a horse-nail, plumstone, or a piece of flint.

The setæ of the oat seem to have a constant tendency to form

into spherical balls, and when felted they sometimes alternate with layers of phosphates, so that when divided the transverse sections of these are found to be marked by concentric lines.

III. The true Oriental Bezoar is found in the wild goat of Persia (*Capra ægagrus*), and is brought to India from the Persian Gulf. In appearance it is black and hard, oval in shape, with a smooth surface, which has a peculiar shiny lustre.

This stone consists entirely of ellagic acid, which is an insoluble organic acid derived from certain constituents of the diet of the Persian goat. This acid can also be extracted from an infusion of gall-nuts when exposed to the air.

Bezoars were frequently set in hoops of gold or silver, having a chain of some metal by which they were suspended in the liquid to which it was desired they should impart their curative virtues.

Koemfer says: "In Persia all people of consequence possess one or more of these stones preserved with great care as valued treasures." A proof of their value is found in the fact that amongst the treasures sent to the Emperor Napoleon the First, by the Shah of Persia, were three Bezoars valued at nearly two hundred pounds.

Five hundred crowns (£125) have been given for one such stone, and Tavernier mentions one, weighing four ounces, which was sold for one hundred and fifty pounds.

The diseases supposed to be cured by Bezoars were of varied character, such as epilepsy, palpitation, vertigo, contagious fevers, etc. It is said to have been a custom in Persia to take a dose of powdered Bezoar at the beginning of the year to protect the body from poison for the succeeding year.

They may have been useful perhaps in some cases, owing to the amount of bile contained in them, and also because they were sometimes steeped in infusions of active medicinal plants.

IV. The Occidental Bezoar.

This is found in the goat of Peru and India, and, as a rule, it is larger, lighter in color, and for the most part without the peculiar black metallic lustre of the true Oriental stone, and is of much less value. The chamois yields what is known as German Bezoar, and another similar stone is found in the llamas of Peru.

The high price of the Oriental Bezoar led to numerous imitations, for the most part made of chalk and pipe clay, frequently gilded to give the high polish of the Eastern stone

By putting butter of antimony under the action of nitric acid an artificial Bezoar can be made, and other imitations were made of vegetable resin identical with the litho-fellic acid of M. Goebel, which he found in a calculus examined by him. These stones are sometimes called resino-bezoardic concretions.

The snake stones of the Portuguese were probably made by the Brahmins, who pretended that they were taken from behind the head of the Cobra da Capello. They were called Pedra di Cobra, and were made of calcined bone-earth finely powdered and mixed with musk and aromatic gums. They were probably of use when applied to wounds, although not quite in the way imagined, for, being highly porous and absorbent, when applied in quick succession to a recent snake-bite, these stones would naturally draw out the poison by capillary action; when one stone fell off another would be supplied until the wound was sucked dry. Koemfer says 28 stones were needed to be applied to effect a cure.

Fossil Bezoars are found in Sicily in sand and clay pits. They are concretions of a purple color, around some usually organic body, and are of the size of a walnut.

V. Concretions of phosphates of magnesia and ammonia. The consideration of these calculi would hardly come within the limits of this paper.

VI. Ambergris.

Concretions found in the Spermaceti whale. This substance is found also floating on the sea upon the coasts of Japan, Coromandel, and Madagascar. It is of very light specific gravity, ash-colored, with black veins and spots. It is supposed to be a product of disease, as it is only found in dead or sickly whales.

One more so-called Bezoar may be mentioned, and then, as far as is known, all the various kinds will have been touched upon.

In the Malay Peninsular there is sometimes found in the cocoanut a stony concretion, properly called *Callapitte*, which is worn by the Malays as an amulet of great value. This is so like Bezoar that it is sometimes mistaken for it, although a purely vegetable product.

THE STUDY OF MOULTING IN BIRDS.

BY WITMER STONE, M.A., CONSERVATOR, ORNITHOLOGICAL SECTION, ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

THE question of change of plumage in birds, even in our commonest species, has never received the attention that it deserves, and, considering the number of ornithologists which we now have in the United States it seems strange that we know so little of the matter.

Perhaps now that the field for the discovery of new species or races of North American birds is narrowing so rapidly, attention will be turned to the study of moulting and other none the less interesting phases of bird life. Comparatively little material seems to have been gathered as yet for the proper discussion of plumage changes for in almost all the private collections of bird-skins that I have examined I have been struck with the lack of specimens illustrating seasonal changes of plumage, the bulk of the material being either adult spring birds or fall birds which have completed the moult.

The reason for this is easily seen, as in August, the season when most birds experience their complete moult, collecting is by no means easy work. The birds themselves are quiet and inactive, which renders them inconspicuous and hard to find; then, also, the specimens secured during the moulting season are difficult to prepare satisfactorily, while the heat of mid-summer renders immediate preparation necessary. Such obstacles should not, however, stand in the way of the collector and those making local collections of birds should aim to have a sufficient series of each species to show all its seasonal changes of plumage.

Having been recently engaged in examining some interesting series of moulting birds, a few words on these and the question of moults in our passerine birds in general may not be out of place.

Change of plumage in birds, as is well known, takes place in two ways (1) by the acquisition of an entirely new set of feathers and (2) by an abrasion or wearing away of portions of the old feathers.

As a matter of fact both of these methods are employed by all our birds though the amount of change and the number of changes during the year vary in different species.

In all our birds there is a moult of all the feathers late in the summer or early in September, when the breeding season is over, and the feathers are in the poorest condition. The moult at this season is an obvious necessity, as without it the birds would be unable to accomplish their autumnal migration and would be but ill prepared to withstand the cold of winter. Specimens secured just before this moult takes place are in a wretched condition, many of the tail feathers are reduced to mere spines and the wing feathers are often more or less broken while the body plumage is very much worn and some patches are often entirely lacking.

In effecting the complete moult the feathers are renewed a few at a time in a regular sequence, and the utility of this can easily be seen for if the old plumage was all lost at once the bird would be unable to fly for some days and would in all probability perish. On the wings the moult begins with the middle feathers and extends outward and inward, corresponding feathers being lost from each wing simultaneously. At the same time the feathers on the sides of the breast, centre of the back, and the wing coverts are renewed. Male bobolinks taken in this state show the process very clearly, and the bright bands of buff forming an inverted V on the breast stand out in relief against the dull black of the old summer plumage. The change of plumage on the other parts of the body follows rapidly, and the new dress is donned in a remarkably short time, with the exception of the last wing and tail quills.

The second method of changing plumage — by abrasion — is best seen in birds having parti-colored plumage where the centre of the feather is of one hue and the margin of another. Of course, abrasion occurs in all birds, but when the feathers are

uniform in color no marked difference is produced by the process. The abrasion begins soon after the autumal moult and continues throughout the year, being effected by the general wear and tear on the plumage and by the action of the bird itself in cleaning its feathers by drawing them through its bill. The margin of the feather—that is the terminal portion of the barbs—seems to become brittle and break off at a slight touch, the point at which the fracture occurs being on the line where the color changes, in parti-colored feathers. In this way the color of a bird may be entirely changed without the loss or gain of a feather, for owing to the shingled arrangement of the plumage only the terminal portion of the feather is seen, and when this is worn off the central and basal portion, which is frequently differently colored, comes into view.

The series of snow-buntings collected in Greenland by the late Peary expedition, which have passed through my hands, taken in connection with winter specimens from Pennsylvania, show this method of plumage change very well. Taking the feathers of the back, for instance; in the winter birds we find them so broadly tipped with white and brown as to give a light-colored appearance to the bird; in the summer specimens, however, the light tips have been entirely lost and the back becomes solid black. The actual shape of these feathers has changed too, for while those of the winter birds were oval, those of the summer specimens are found to be pointed, with the sides somewhat concave. This was the shape of the black central portion of the feathers in the winter, and when the light margin has been worn off the black portion is, of course, all that remains. This change of shape in the feathers, due to abrasion, is best seen, however, in the curlews and other birds in which the back and rump feathers have peculiarly lobed black centres with light-re-colored margins. The breeding birds of these species will be found to have these feathers deeply sinuated along the margins due to the loss of the light portions, between the black lobes, in striking contrast to the oblong oval feathers of the fall plumage.

In birds which experience a loss of the tips of the feathers by abrasion, but which, owing to the manner of coloration of the feathers do not show any marked change in the general coloration of their plumage, as in the common Song Sparrow, the fall specimens can still be distinguished from spring ones at a glance; as the plumage in the former is long and blended while in the latter the feathers have the appearance of having been clipped with shears.

As has already been said, these two methods of changing plumage (1) by a complete moult, and (2) by abrasion, take place in all birds, but the time and extent of the changes differ in different species.

Our passerine birds may be grouped in three classes according to the changes which take place in their plumage during the year. The most usual system is (1) a complete moult in the autumn or late summer and (2) an abrasion of the tips and margins of the feathers in the spring accompanied by a more or less extensive renewal of the smaller body of feathers.

In some species the acquisition of new feathers in the spring is so slight that it is scarcely apparent and can only be detected by careful scrutiny while in other cases considerable patches of feathers are renewed.

In the Sharp-tailed Finch, of which I have examined a series of eighty specimens taken during every month of the year on the New Jersey salt marshes by Mr. L. N. DeHaven and myself, I find a considerable acquisition of new feathers taking place in April; in some individuals even the tail feathers are being renewed, which is not surprising as owing to the habits of the bird the plumage must become very much worn. Many male birds which require several years to attain their full adult plumage acquire some of the feathers characteristic of the adult plumage at this spring moult. The White-throated Sparrow, for instance, acquires additional white feathers on the throat and head, and yellow ones in front of the eye, and the Myrtle Warbler experiences an increase in the yellow feathers on the sides of the breast.

The second system of moulting consists of (1) a complete moult in the autumn or late summer and another moult in the spring, which is either complete or excludes the remiges and rectrices. Such birds as the Scarlet Tanager, Indigo bird, etc., are examples of this class. Owing to the fact that many of them winter in the tropics it is difficult to obtain specimens showing the progress of the spring moult, and we are forced to a comparison of fall and spring birds. The Goldfinch, however, which can be obtained throughout the year in this latitude, shows the double moult very nicely, and specimens taken in April and September will be found respectively to be acquiring and losing the familiar bright yellow plumage, the gray feathers of winter appearing in the fall birds and disappearing in the spring ones.

The third system of moults seems the most complicated of the three, and was first pointed out by Mr. Frank M. Chapman in the case of the bobolink.

This bird has a complete moult in the late summer, then another complete moult in the early spring before it starts north from the tropics, and between that time and the breeding season an extensive abrasion, which again completely alters the appearance of the plumage. (See *The Auk*, 1890, p. 120.)

Specimens of the Rose-breasted Grosbeak which I have recently examined, taken in South America, seem to indicate that this species has a similar system of moulting to that of the Bobolink.

So far as I can ascertain, the adult male in fall assumes the striped brown dress of the female, but differs from it in having bright pink under wing-coverts and a marked pink suffusion on the breast. Opposed to this is the well-known black and white plumage of the breeding bird with its brilliant pink breast. Now the South American birds above alluded to are different from either of these. They possess the full plumage of the breeding bird, but every feather has a light brown or buff edging which gives the bird a "veiled" appearance and conceals to a certain extent the striking markings of the nuptial dress.

These specimens indicate pretty clearly that in addition to the annual fall moult the male Rose breast has a complete moult during the winter or early spring, assuming at this time a dress which differs decidedly from the breeding plumage, but which changes into it by means of extensive abrasion.

The lower orders of birds have as a general thing still more complicated moults than are found in the Passeres, and of most of them comparatively few of the details are known.

In consideration of these facts as well as the great interest that this study possesses, I cannot but recommend to all collectors to have this matter in view in making future additions to their collections and to look over the material which they already possess with an eye to the moult, feeling sure that they will be well repaid for their pains.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Comparative Longevity.

Among mammals the epoch of maturity is usually stated as reached in one-fifth of the animal's life. Thus the ages of maturity and periods of life of several forms are about as follows: horse, bull, four to twenty; sheep, two to ten; rabbit, one to five; but there are exceptions, such as the cat, which matures in one year and may live twenty.

It is assumed that man matures at twenty, and hence, by the rule, should live to be one hundred, as does the elephant, which matures in its twentieth year. But, I think that writers upon longevity, such as Hufeland, Flourens, Quatrefages, Thoms, etc., when commenting upon these relationships, have overlooked the fact that the general rule holds better for the lower races of men who mature sooner than the civilized, to whom the retardation of early development is an advantage, as it prolongs the plastic, receptive period.

The helplessness of the human infant at birth, and the length of time it needs parental care, in these respects differing from

other mammals, enables training of a progressive nature in succeeding generations, and whether this lengthened immaturity is a result, or cause, or both, it is a great advantage. We may be justified in regarding the immaturity as prolonged beyond that of other mammals rather than that man's longevity is proportionately less.

S. V. CLEVENGER.

Chicago, Ill.

BOOK-REVIEWS.

Handbook of Australian Fungi. By M. C. COOKE. London, 1892. 458 p. 36 pl.

Select Extra-Tropical Plants, Readily Eligible for Industrial Culture or Naturalization. By BARON FERD. VON MUELLER. 8th Edition. Melbourne, 1891. 595 p.

HE who nowadays would keep posted in regard to the progress of science must frequently turn to the southern hemisphere. In South America, in South Africa, and in Australia the devotees of science have been and are working. The recent organization of an Australasian Association for the Advancement of Science is an effort toward a union of scientific men such as already exists in North America, England, France, and Germany; and it will do much toward unifying the work of the numerous scientific bodies that have long existed in the various colonies. The vast extent of territory and the distances between the capitals of the several colonies is paralled only by our own country, but here we have the advantage of a greater net-work of railways and more rapid means of communication. From Hobart, the capital of Tasmania, to Christchurch, New Zealand, where the meeting of the Association was held in 1891, the distance is about 1,000 miles. From Sydney, in New South Wales, it is over 1,200 miles; from Adelaide, in South Australia, the distance is over 2,000 miles; while it is even further than this from Brisbane, in Queensland. All of these places are included in the comprehensive Australasian Association.

To enumerate the scientific societies in Australia would require considerable space. We cannot, however, forbear alluding to some of the more important, as shown by their publications. There is, for example, the Royal Society of New South Wales, that has issued 24 volumes of proceedings; the Royal Society of Victoria, and the New Zealand Institute, also each with 24 volumes; the Linnæan Society of New South Wales, with 6 volumes; the Australasian Association for the Advancement of Science, 3 volumes, and the Royal Society of Tasmania, that has been publishing since 1863. Besides these there are innumerable irrigation, engineering, mining, and geological reports published by the governments of the several colonies. The agricultural side is represented by reports of the secretaries for agriculture of Queensland, New South Wales, etc., and by the grand publications of Mueller on the Eucalypts, and the well-edited agricultural journal of New South Wales. To mention all the official publications would be a task too great to be undertaken here. But from what has already been said, it must be manifest that the Australian colonies are not one whit behind the rest of the civilized world in their contributions to scientific and practical literature.

There is, of course, a reason for this activity. The country is new, and is full of wonderful birds and animals and plants; and the men who left behind them in Europe an exhausted field, as far as novelties in science go, find in the colonies a virgin field. The vegetation, the animal life is so different from that of the northern hemisphere that we may look forward for years to come for additions to our knowledge of the productions of the wonderful island.

Two books that have lately been added to botanical literature from Australia are those mentioned at the head of this article. Both are from veterans in their respective fields, one a cryptogamist, the other a phanerogamist. Both have a world-wide reputation, and both have exceeded the three-score and ten years of allotted human life and are yet active workers. Although here brought into conjunction, the men themselves are residents of opposite sides of the globe. The names of Dr. M. C. Cooke and Baron Ferd. von Mueller must live as long as the science of botany exists. Students of science are grateful that they have been spared long enough to give them two such valuable works.

The "Handbook of Australian Fungi" is a compilation of the descriptions of these plants that have at various times been published in widely-scattered volumes. The work was undertaken at the request of the Australian colonies, and is published under their authority. A limited edition only has been printed, some 500 copies, and the major part of it has gone to Australia. The total number of species given in the volume is 2,087, exclusive of varieties. This, in comparison with the total number of species recorded by Saccardo, some 36,000, seems small when the extent of country covered is considered. But it is of course very improbable that all the Australasian forms have been described. Indeed, scarcely a month passes but some new forms are recorded, and it is probable that they will continue to be sent in for many years to come.

The largest order represented is Hymenomycetes, with 1,178 species, more than half the total number recorded. This is probably due to the fact that the species are large, or at least conspicuous, and are therefore collected. Another order, however, also with conspicuous members, the Gastromycetes, is exceptionally well represented, as there are 174 species out of a total known from the whole world of 650 species. Among the interesting species of this family we note *Podaxis indica*, a plant bearing a surprising outward resemblance to *Coprinus cornatus*, but of course with a very distinct internal structure. There is also *Xylopodium ochroleucum*, with a long stalk and a peridium marked with numerous angular projections.

The occurrence of a number of species in the two islands of Ceylon and Australia is noted as a curious fact in geographical distribution. The flora in general and the fauna as a whole is so distinct in these two countries that it is difficult to account for this fact. It is true that plants in many cases seem to overstep the bounds that have been assigned to them by botanists, and do not appear to follow the ordinary laws of distribution. Especially is this true of ferns and fungi, two classes having spores so minute as to be capable of transportation long distances through the air by winds. Some species thus become cosmopolitan, but at present we cannot account for finding some species of such conspicuous genera as *Lepiota, Hymenochæte, Stereum aseröe*, etc., *only* in Ceylon and Australia. It is of course possible that when the intervening islands of New Guinea, Java, Borneo, Celebes, Sumatra, and other smaller ones of the Malay archipelago are explored, that the same species may be found there. That would do away with the anomaly. Comparing the flora with that of Europe, Dr. Cooke finds that 332 of the Hymenomycetes are exclusively Australian, 472 are also found in Europe, and 370 are common to Australia and some other country. Of the Gastromycetes only 31 out of 173 species are European.

In the introduction Dr. Cooke gives condensed accounts of the principal groups, with tables of the genera. This, while not claimed to be complete in any sense, cannot but be of assistance to the student. The species will have to be identified from the descriptions. This is to some extent facilitated by the plates. Of the 36, 20 are colored, and on them are given 377 figures. A list of the authorities cited, and a full index are valuable portions of the book. The descriptions of the plates would have been more convenient for reference had the page where each species is described been given.

The second one of our titles is a new edition of an old book, but it is such a valuable book that it deserves to have general attention called to it. The early editions being exhausted, and there being much new matter in hand, the government of Victoria publishes this volume. To give an adequate idea of its contents would be to index it. We can only refer in a general way to its contents and perhaps mention a few of the more important and interesting facts presented. We have also been struck with Baron Mueller's remarks in both preface and postscript. In the former, after reviewing in a general way the contents of the volume, and mentioning the various editions of it that have appeared from time to time, he says:—

"The fact that this work through successive editions and ex-

tensive issues came into use over a large portion of the world, whether for educational, or rural, or journalistic, or touristic wants, has been most gratifying to the author; but this brightness is dimmed by the circumstance that the book has not unfrequently been used even in public departments with perhaps unintentional evasion of all literary or any other acknowledgment. Nor did hardly ever words of appreciation reach the author from wherever rural successes were gained from even practical exertions of the author."

This is too often the experience of the literary and scientific man. His ideas, his knowledge, are seized upon, or his books and papers are received and no hint of the benefits he has conferred ever reaches his ears; no indication is ever apparent that the seed has fallen upon fertile ground. In his postscript the author requests persons using the book to send him suggestions or additions, concluding with the following words:—

"While approaching the eighth decade of his life, the author cannot hope to see many more editions of this work, brought up to the newest standard, through the press himself; but, as he may perhaps still be able to publish one more edition before passing away, he is now particularly eager that the next issue should by some special efforts be rendered as complete as this, within the knowledge of the present days, can be accomplished. Such help, furthermore, would really be a recompense only from those who in using this book derived some practical benefit or instructive advantages from its pages."

The number of practical suggestions is endless. For example, in speaking of the "Black Wattle" of Australia, mention is made of the great value of the bark for tanning purposes. One and one-half pounds of this will do as much as five pounds of English oak bark. The tree is easily grown, and the seeds may be sown broadcast or in drills. It grows on the poorest and dryest soil, and a return may be expected in from five to ten years. Full-grown trees yield about 100 pounds of bark. It grows about an inch in diameter annually, and is hardier than *Eucalyptus globulus* (the gum tree). On this account it would be valuable to introduce into our Southern States and Southern California. The seeds retain their vitality for several years, and can be obtained in Melbourne for 5 shillings per pound, each pound containing from 30,000 to 50,000 grains. They germinate best after being soaked in warm water.

The "rain-tree" is described as reaching a height of 70 feet, with branches extending 150 feet away from the trunk. It grows rapidly and makes an admirable shade-tree in countries where there is no frost, and where the rainfall fluctuates between thirty and sixty inches annually. The leaves shut up at night and allow rain and dew to reach the ground beneath, so that grass will grow. The pods are produced in great abundance, and are fattening to cattle, which feed upon them greedily.

The tea-plant is stated to be hardy near Melbourne, enduring light frosts and scorching hot summer winds. It thrives best, however, in humid valleys with rich alluvial soil, where there are springs for irrigation. The greater the rainfall the larger the yield of tea. In Japan the plant is cultivated as far north as 43° latitude, where the thermometer occasionally falls to 16° F., and the ground remains frozen several inches deep for weeks. In 1840 India sent her first sample of tea to European markets, and in 1864 exported 7,800,000 pounds. In 1889 the amount had risen to 101,000,000 pounds. Three hundred pounds to the acre is the average yield in India. The author believes that for many years to come it will be a profitable business to raise tea-plants for the seeds alone.

Some twenty-five pages are devoted to the *Eucalyptus*, full accounts being given of several of the species. The "giant gum tree" (*Eucalyptus amygdalina*) reaches a height of 415 feet. The tree sometimes measures 69 feet in circumference at the ground, and one has been recorded as 33 feet in diameter at 4 feet from the ground. One 78 feet from the ground was 9 feet in diameter.

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

Jan. 21.—T. C. Mendenhall, The Use of Planes and Knife-Edges in Pendulums; R. S. Woodward, The Use of Long Steel Tapes for Measuring Base Lines. A report will be presented from the committee appointed to consider suitable commemoration exercises at the 400th meeting of the society.

Agassiz Scientific Society, Corvallis, Ore.

Jan. 11.—G. W. Shaw, Gravitation a Form of Energy.

Publications Received at Editor's Office.

A FREE LAND. The Cry of the Children. London, Williams & Norgate. 128 p. 12°.

BECKER, G. F. Finite Homogeneous Strain, Flow and Rupture of Roc s. Rochester, N. Y., Geol. Soc. Amer. 8°.

BOYD, R. NELSON. Coal Pits and Pitmen. New York, Macmillan & Co. 256 p. 12°. $1.

CARUS, P. Truth in Fiction. Chicago, OpenCourt Pub. Co. 111 p. 8°. $1.

CONGRES INTERNATIONAL DES AMERICANISTES. Compte-rendu de la Nuitième Session. Paris, Ernest Leroux. 704 p., pl. 8°.

DUMBLE, E. T. Report on Brown Coal and Lignite of Texas. Austin, Tex., Geolog. Survey. 243 p., pl. 8°.

FOSTER, L. S. The Published Writings of George Newbold Lawrence, 1844–1891. Washington. Smithsonian Inst. 124 p. 8°.

LODGE, Oliver. Pioneers of Science. London and New York, Macmillan. 404 p. 12°. $2.50.

MACDONALD, A. Criminology. Introduction by Dr. C. Lombroso. New York, Funk & Wagnalls Co. 416 p. 12°.

SIMMONS, H. M. The Unending Genesis. Chicago, C. H. Kerr & Co. 111 p. 24°. 25 cents.

TALMAGE, J. E. Domestic Science. Second Edition. Salt Lake City, Utah, G. Q. Cannon & Sons Co. 369 p. 12°.

THE JOURNAL OF POLITICAL ECONOMY. Vol. I., No. 1. Dec., 1892. Chicago, The University Press. 161 p. 8°. $3 per year.

WORLD'S FAIR ELECTRICAL ENGINEERING. An Illustrated Monthly Magazine. Chicago, Elec. Eng. Pub. Co. 56 p. 8°. $3 per year.

It grows with great rapidity, in France reaching a height of 50 feet in 8 years. It is hardy in the milder parts of England. It yields a valuable volatile oil, and it is said when combined with thymol and other antiseptics to be efficacious in treatment of scarlet fever and other infectious diseases, especially as an external application. Fresh branches placed under the bed of phthisic patients act as an antiseptic, a sedative, and a hypnotic. The plant is also useful in subduing malarial effluvia in fever districts.

We cannot go further into details, but commend the volume to all botanists and horticulturists. Various indexes, of trees best adapted for certain purposes, of genera referred to, of synonyms, of vernacular names and of species best adapted to various regions of the globe, add greatly to the value. The price of the book is only five shillings.

JOSEPH F. JAMES.

Washington, D.C., Jan. 12.

A Text-Book of Least Squares. By MANSFIELD MERRIMAN. 6th Ed. New York, J. Wiley & Sons. 1892. 198 p. 8°.

Theory of Errors and Method of Least Squares. By W. W. JOHNSON. New York, J. Wiley & Sons. 1892. 174 p. 12°.

WE have here two excellent works, written by two able men, and illustrating in an interesting manner those different views of identical principles and methods which independent thinkers are always able to exhibit, however old and well-worked the subject. Professor Merriman wrote his first edition of this treatise in 1877, with the purpose of presenting the facts and principles of this somewhat abstruse subject in such form as to make them easily comprehended by students and by engineers, in practice often less familiar than the student with work underlying the higher mathematics. That treatise, while successful, served nevertheless, to indicate where still further improvement might be effected, and the present is a re-written treatise, of which the major portion was prepared and printed in 1884, as a second edition. The sixth edition, now before us, contains the same matter in substance, but with the usual and unavoidable printers' and other errors, always found in first issues, removed, and some improvements introduced in the treatment of adjustments of two related quantities, and with notes of interest appended. The book has become a standard work of reference, as well as a text-book, and needs no special commendation from us, other than the expression of full agreement with the verdict of the purchasers and users of five issues, who have made necessary this sixth edition.

Professor Johnson has condensed his work into a smaller compass than the preceding; but it is all the more rich and "meaty." The author follows Gauss in the methods laid down in "Theoria Motus Corporum Cœlestium" (Werke, VII.), and treats the "reduced observation equations" by the more explicit methods introduced by Jordan ("Handbuch der Vermessungskunde," 1888) and later writers, including Oppolzer, to whom he goes for some of the more important forms adopted in computations. The book is systematic, logical in its sequence, and well illustrated by carefully chosen examples in application. Appended are tables of values of the probability-integral and of powers and roots.

When a mathematician of eminence undertakes thus to provide a treatise upon a subject of importance, and compiles a text-book, for young students, not only the youth who is thus provided with a text-book but the whole world of observers employing such methods become more indebted to him than to the less distinguished and less talented man doing similar work; we have the assurance, not only that the book will serve its purpose, but that it represents the latest and best thought and labor of the time. This assurance is worth much to teacher and pupil; and it can hardly be doubted that the use of this little treatise will extend beyond the limits of the United States Naval Academy, where it was originally intended by its author to be used, in his own classes.